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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/605,108
Filing Date: September 09, 2003
Appellant(s): CHIDAMBARRAO ET AL.

Andrew M. Calderon
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 01/04/07 appealing from the Office action mailed June 08, 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

6200836	Yoo	03-2001

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 16, 17, 18, 21, 22, 23, 24, 25, 26, 27, 28, and 30-39 are rejected under 35 U.S.C. 103(a) as being unpatentable over the applicant's admitted prior art of this application (AAPA) in combination with Yoo (US patent 6,200,836).

With respect to claims 16, 17, 18, 21, 27, 38, and 39, AAPA teaches a method for manufacturing a semiconductor device, comprising steps of (see the Background of Invention of this application):

Forming source and drain regions in an upper surface of a Sage-based substrate, the source and drain region containing an n-type impurity.

AAPA fails to teach forming source and drain extension regions in the upper surface of the substrate and ion implanting interstitial element or oxygen into the source and drain extension regions.

Yoo teaches forming source and drain extension regions 16,18 in the upper surface of a substrate and ion implanting interstitial element or oxygen into the source and drain extension regions to prevent increase in threshold voltage, eliminate leakage current, and achieve high performance. See fig. 2 and associated text and col. 3, lines 1-10.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to incorporate the above teaching of Yoo into the process of AAPA to obtain the above benefits.

Further with respect to claim 16, since AAPA in combination with Yoo teach implanting oxygen into the source and drain extension regions as claimed, the vacancy concentration in the source and drain regions would inherently reduce.

Further with respect to claim 16, it is submitted that since AAPA in combination with Yoo teach the claimed invention, the resulting low-vacancy regions would inherently and substantially overlap the source and drain extension regions.

With respect to claim 30, AAPA further teaches forming an Si cap layer on the SiGe based substrate and the tension of the Si cap layer is inherently strained biaxially to match an underlying relaxed SiGe lattice. See [0003] of the Background of the Invention of this application.

With respect to claim 31, Yoo further teaches forming sidewalls on side surfaces of a gate electrode 14 before ion implanting, whereby the gate electrode is protected from ion implanting. See figs. 1-3 and associated text of Yoo.

With respect to claim 32, since AAPA in combination with Yoo teach the same process as claimed, the vacancy concentration would be inherently reduced by annihilation of excess vacancies in the source and drain extension regions.

With respect to claim 33, Yoo further teaches ion implantation of interstitial element after forming the source and extension regions.

However, It would have been obvious to one of ordinary skill in the art of making semiconductor devices to perform ion implantation of interstitial element before forming the source and extension regions because the selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results. In re Burhans, 154 F.2d 690, 69 USPQ 330 (CCPA 1946).

With respect to claim 34, Yoo teaches using oxygen as the interstitial element but fails to teach using nitrogen as the interstitial element.

However, the use of nitrogen as interstitial element is well-known in the art.

With respect to claim 35, since AAPA in combination with Yoo teach the same process as claimed, the interstitial element would inherently create additional

interstitials which inherently react with and annihilate excessive vacancies in the SiGe based substrate.

With respect to claim 36, since AAPA in combination with Yoo teach the same process as claimed, the ion implantation of interstitial element would inherently reduce an N-type impurity in source and drain regions, thereby improving roll-off characteristics.

With respect to claim 37, Yoo further teaches that the ion implantation is performed in a self-aligned manner by using a gate electrode 14 as a mask. See figs. 1-3 and associated text of Yoo.

With respect to claims 38 and 39, AAPA further teaches forming an Si cap layer on the SiGe based substrate.

Further with respect to newly presented claims 38 and 39, Yoo in combination with AAPA further teach forming a gate electrode on the Si cap layer.

Further with respect to newly presented claims 38 and 39, AAPA in combination with Yoo further teach forming sidewalls on sides of the gate electrode.

Further with respect to claims 38 and 39, AAPA in combination with Yoo further teach forming source and drain extension regions in an upper surface of the SiGe substrate.

Further with respect to claim 38, AAPA in combination with Yoo further teach ion implanting an interstitial element into the source and drain extension regions to inherently reduce vacancy concentration in the source and drain extension regions, wherein the ion implantation occurs after the sidewalls are formed

Further with respect to claim 38, since AAPA in combination with Yoo teach the claimed invention, the vacancy concentration in the source and drain extension regions would be inherently reduced in order to annihilate excess vacancies or trap vacancies, wherein the ion implantation or reducing occurs after the sidewalls are formed and the formed low-vacancy regions would inherently and substantially overlap the source and drain extension regions.

With respect to claim 28, Yoo further teaches implanting oxygen into the source and drain regions. See claim 1 of Yoo.

With respect to claim 29, since Yoo teaches implanting oxygen into the source and drain regions as claimed, the vacancy concentration in the source and drain regions would inherently reduce.

With respect to claim 25, Yoo further teaches annealing treatment. See col. 4, lines 30-40.

With respect to claim 26, AAPA in combination with Yoo teach performing heat treatment but fail to teach the ranges for the annealing temperature and annealing duration.

However, it would have been obvious to one of ordinary skill in the art of making semiconductor devices to determine the workable or optimal value or ranges for the annealing temperature and duration through routine experimentation and optimization to obtain optimal or desired device performance because in the absence of unexpected result it has been held that it is not inventive to discover the optimum or workable ranges of a result-effective variable within given prior art conditions by routine experimentation. See MPEP 2144.05.

With respect to claim 22, AAPA in combination with Yoo teach implanting oxygen into the source and drain extension regions but fail to teach the ranges for implantation concentration and energy.

However, it would have been obvious to one of ordinary skill in the art of making semiconductor devices to determine the workable or optimal value or ranges for the implantation concentration and energy through routine experimentation and optimization to obtain optimal or desired device performance because in the absence of unexpected result it has been held that it is not inventive to discover the optimum or workable ranges of a result-effective variable within given prior art conditions by routine experimentation. See MPEP 2144.05.

With respect to claim 23, AAPA in combination with Yoo appear to fail to teach forming a si cap layer.

However, the formation of a silicon cap on semiconductor device is well-known.

Further with respect to claim 23, AAPA in combination with Yoo further fail to teach the ranges for the concentration peak for oxygen and N impurity of the source and drain extension regions and the concentration peaks of oxygen and n impurity of source and drain extension regions are at the substantially same height from upper surface of a silicon cap layer.

However, it would have been obvious to one of ordinary skill in the art of making semiconductor devices to determine the workable or optimal value or ranges for the concentration peaks for oxygen and n impurity of the source and drain extension regions through routine experimentation and optimization to obtain optimal or desired device performance because in the absence of unexpected result it has been held that it is not inventive to discover the optimum or workable ranges of a result-effective variable within given prior art conditions by routine experimentation. See MPEP 2144.05.

(10) Response to Argument

In response the appellant's arguments in the paragraph bridging pages 6 and 7 of the appeal brief dated 01/04/07, it is submitted that AAPA in combination with Yoo teach ion implanting an interstitial element or oxygen into the source and drain extension regions or LDD regions. Further, it is submitted since AAPA in combination with Yoo teach the claimed processes, the ion implanting an interstitial

element or oxygen into the source and drain extension regions or LDD regions would inherently form low-vacancy regions that substantially overlap the source and drain extension regions to inherently reduce vacancy concentration. Further, it is submitted that claims don't require exclude ion implantation into a small or large portion of the source and drain extension regions or LDD regions. Further, it is submitted that end regions (32 of figs. 2 and 3 of Yoo) of 16 and 18 constitute LDD (light doped drain) regions or the source and drain extension regions (these two terminology are used interchangeably). It is submitted that the AAPA in combination with Yoo teach ion implantation of oxygen into substantial portions of the source and drain extension regions or LDD regions, the resulting regions would inherently substantially overlap the source and drain extension regions or LDD regions.

In response the appellant's arguments in the paragraph bridging pages 8 and 9 of the appeal brief dated 01/04/07, it is submitted that Yoo is being relied on only for the broad teaching of ion implanting an interstitial element or oxygen into the source and drain extension regions or LDD regions not the specifics (such as ion implantation concentration and energy or angle of implantation) of the ion implantation.

In response the appellant's arguments in the first full paragraph on page 11 of the appeal brief dated 01/04/07, it is submitted that the vertical sides of gate electrode 14 of fig. 2 of Yoo constitute sidewalls of on sides of the gate electrode 14, sidewall spacers are not being relied on in the rejection.

In response the appellant's arguments in the first and second full paragraphs on page 11 of the appeal brief dated 01/04/07, it is submitted that the appellant has the burden of proving the criticality of the claimed range.

In response the appellant's arguments in the paragraph bridging pages 17 and 18 of the appeal brief dated 01/04/07, it is submitted that the appellant does not appear to challenge the validity of the specific well-known teachings as being relied in the rejection.

In response the appellant's arguments in the paragraphs on page 19 of the appeal brief dated 01/04/07, it is submitted that the appellant has the burden of proving the criticality of the claimed range.

In response the appellant's arguments in the paragraphs on page 20 of the appeal brief dated 01/04/07, it is submitted that the appellant has the burden of proving the criticality of the claimed range.

In response the appellant's arguments in the paragraphs on 21 of the appeal brief dated 01/04/07, it is submitted than the appellant does not appear to challenge the validity of the specific well-known teachings as being relied in the rejection.

In response the appellant's arguments in the paragraphs on 22 of the appeal brief dated 01/04/07, it is submitted Yoo teaches annealing. See co. 4, lines 30-40

of Yoo. It is submitted that the appellant does not appear to challenge the validity of the specific well-known teachings as being relied in the rejection.

In response the appellant's arguments in the paragraphs on pages 23 and 24 of the appeal brief dated 01/04/07, it is submitted that the appellant has the burden of proving the criticality of the claimed range.

In response the appellant's arguments in the paragraphs on 26-34 of the appeal brief dated 01/04/07, it is submitted that the appellant does not appear to the challenge the validity of the specific well-known teachings as being relied in the rejection.

In response the appellant's arguments in the paragraphs on page 27 of the appeal brief dated 01/04/07, it is submitted that since AAPA in combination with Yoo teach the claimed processes, the vacancy concentration would inherently be reduced by annihilation of excess vacancies in the source and drain extension regions.

In response the appellant's arguments in the paragraphs on page 28 of the appeal brief dated 01/04/07, it is submitted that it would have been obvious to one of ordinary skill in the art of making semiconductor devices to perform ion implantation of interstitial element before forming the source and extension regions because the selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results. In re Burhans, 154 F.2d 690, 69 USPQ 330 (CCPA 1946).

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

LP.

L. Pham

Conferees:

Wael Fahmy W.F

Ricky Mack RM